Distribution of Menhaden, Genus *Brevoortia*, in the Gulf of Mexico[1]

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ABSTRACT

There are three menhaden in the Gulf of Mexico. *Brevoortia patronus* ranges around the northern Gulf from Brazos Santiago, Texas, to Tampa Bay, Florida, and supports a large commercial fishery centered in the area of greatest abundance, the Louisiana coast. The fish grows up in estuarine areas and ranges into fresh water at smaller sizes. It ranges into pure sea water and as far offshore as 25 miles. The greatest depth at which it has been taken is 20 fathoms. *Brevoortia gunteri* and *B. smithi* are fine-scaled species that live in the western and eastern Gulf, respectively. (The latter species is also found in the Atlantic.) Both enter fresh waters at small sizes. The greatest depth at which they have been taken is 8 fathoms, and the offshore salinity limit is unknown. The known range of *B. gunteri* extends from Chandeleur Sound, east of the Mississippi River, around the shores of the western Gulf to Campeche, Mexico. It is not often caught in the eastern part of its range, and the greatest abundance seems to be in the western Gulf. The known range of *B. smithi* is extended from Cedar Keys, Florida, to Chandeleur Sound, Louisiana, where all three species of Gulf menhaden come together. *B. smithi* ranges also southward to the Caloosahatchee River, Florida. *Brevoortia gunteri* and *B. patronus* have been recorded in the Laguna Madre of Texas at salinities of 60 *per mille*. *Brevoortia gunteri* and *B. smithi* apparently grow to considerably larger size than *B. patronus*, but they are much less abundant and are not important in the commercial fishery.

INTRODUCTION

The menhaden fishery of the Gulf and Atlantic coasts of the United States exceeded 2 billion pounds production in 1956 and 1959. It is the only fishery in North America that ever yielded such a high catch. Menhaden are also of general ecological importance because of their vast numbers. Several years before the Gulf menhaden fishery approached present production levels, *Brevoortia patronus* Goode was ranked among the three most abundant fishes of large species mass in the northern Gulf waters (Gunter, 1941). The present account summarizes records on the distribution of menhaden in the Gulf of Mexico and gives certain new information.

Brevoortia patronus Goode, 1878

Goode (1879) stated that the first Gulf menhaden received by the National Museum were collected in west Florida in 1864, and he quoted a lighthouse keeper who had seen vast quantities of the fish in the Matagorda Bay (Texas) region in 1872. Before the above account was published Goode (1878) described the common Gulf species, *Brevoortia patronus*. The valid part of his description (see *B. gunteri* below) was based on specimens from Brazos Santiago, Texas, at the southern end of the Laguna Madre, near the Mexican border, which remain the southwesternmost known.

Hildebrand (1948) stated that no specimens of *B. patronus* were available from east or south of Apalachicola in the eastern Gulf, but he called attention to the record of Henshall (1894) from Tampa. Henshall's record is questionable because it could have involved *B. smithi*, now known from that area. Briggs (1958) seems to have accepted Henshall's record, for he gave the southern range of *B. patronus* on the Florida coast as Tampa. The listing of *B. patronus* among the fishes washed up on the beach at Fort Myers Beach, Florida, after a red tide in 1947 (Gunter *et al.*, 1948), was also possibly erroneous. Until quite recently, there was no dependable record of *B. patronus* south of Cedar Keys in the eastern Gulf. Suttkus (1958) examined two specimens from Cedar Keys. Springer and Woodburn (1960) reported several specimens of *B. patronus* from the Tampa Bay area, the largest one of which was 135 millimeters in standard length. Gunter and Gordon E. Hall have recently taken young fish from the Caloosahatchee River, extending the known range southward about 30 miles.

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Various workers have shown that *B. patronus* is quite common in inshore waters, both in the bays and shallow Gulf. Gunter (1936, 1938a, b), Suttkus (1956), and Gunter and Shell (1958) have indicated considerable abundance of *B. patronus* in shallow Louisiana waters; Reid (1955a, b; 1956, 1957) and Simmons (1957) have given similar information for Texas waters. These observations also demonstrate that young menhaden are raised in the bays, sometimes in waters of very low salinities. Gunter and Shell took small *B. patronus* in Grand Lake, Louisiana, where the salinity varied from 0.10 to 0.19 parts per thousand, a level which is considered to be in the fresh-water range. Gunter (1956) and Briggs (1958) listed *B. patronus* as euryhaline.

The common Gulf menhaden is a shallow-water fish, but information on its offshore range is limited. Hildebrand (1954) wrote that shrimp trawlers sometimes encountered menhaden in such numbers that the trawls burst from weight of the fish. He took 14 *B. patronus* in one trawl haul at 17 fathoms off St. Joseph Island, Texas, and one fish at 18 fathoms off Corpus Christi Pass. Salinities were not determined but presumably the fish were in pure sea water. Simmons (1957) noted that *B. patronus* was commonly taken in waters of salinity up to 60 parts per thousand in the hypersaline Laguna Madre of Texas. There are, however, no published records of salinity determinations in the open Gulf to prove that *B. patronus* enters undiluted sea water. Christmas, Gunter, and Whatley[2] recorded salinities at 87 sets of menhaden purse seiners, mostly in Louisiana around the mouth of the Mississippi River, with a few in Mississippi and Alabama waters. Seventy percent of the 2 million pounds of menhaden caught were in waters ranging from 5 to 24 parts per thousand; the highest salinity recorded for any catch was 31.6.

On January 7, 1959, the senior author caught one menhaden in a surface gill net 25 miles south of Petit Bois Island, Alabama, where the water was slightly over 19.8 fathoms deep. On February 21, 1959, C. E. Dawson, of the Gulf Coast Research Laboratory staff, took one *Brevoortia patronus*, 87 millimeters long, in a trawl at a depth of 20 fathoms, 18 miles south of Grand Isle, Louisiana. The bottom salinity was 36.2 *per mille*. On December 11, 1959, U. S. Fish and Wildlife Service biologists aboard the *M/V Oregon* caught three *B. patronus* at two Gulf stations, 2694 and 2695, in midwater trawls where the total depths ranged from 40 to 55 fathoms. On December 10, at station 2693, where the depth was 35 fathoms, another specimen was taken by dip net at the surface. These fish ranged from 153 to 199 millimeters in fork length. The locations are approximately 25 nautical miles east of the nearest land, the Pass à la Loutre mouth of the Mississippi River.

Biologists have not studied variations in abundance of Gulf menhaden, but there are other avenues of information. The spread of menhaden plants along the Gulf coast is from Port Arthur, Texas, to Pascagoula, Mississippi, with intermediate locations at Cameron and Empire, Louisiana. These locations are all within working distance of the rich, estuarine waters of the Louisiana coast, and the menhaden crews fish these waters most heavily.

The U. S. Fish and Wildlife Service records fluctuations in annual production of fishing areas. Mr. Hermes Hague of the Statistical Section has determined the source of Mississippi menhaden landings by the interview method. His records show that from 1954 to 1958, inclusive, Louisiana waters produced almost 70 percent of the menhaden landed in Mississippi. Interviews[3] with Texas menhaden plant operators indicated that they were of the opinion that over the past 5 years Louisiana waters yielded about 60 percent of the menhaden landed in Texas. Louisiana plants handle the major part of the annual menhaden catch and almost all of it comes from their own waters (Table 1). From 1954 to 1958, inclusive, about 86 percent of the average annual 450-million-pound catch came from Louisiana waters.

Brevoortia gunteri Hildebrand, 1948

Hildebrand (1948) described this small-scaled menhaden from specimens taken in Texas waters and "one half-grown specimen from the vicinity of Grand Isle, La." He gave the range of *B. gunteri* as Grand Isle, Louisiana, to the mouth of the Rio Grande, Texas. The Rio Grande records were based on

[2]Christmas, J. Y., G. Gunter, and E. C. Whatley. Manuscript. A study of fishes caught around the mouth of the Mississippi River and in Mississippi Sound in menhaden purse seines.

[3]Conducted by Hermes Hague of the U. S. Fish and Wildlife Service.

TABLE 1.—*Menhaden landings of the Gulf states for the years 1954-1958, and estimated catches from Louisiana waters landed in other states*[1]

[Thousands of pounds]

Area	Total landings	Catch from Louisiana	Percentage from Louisiana
Louisiana	1,293,554	1,293,554	100.0
Mississippi	645,630	451,117	69.9
Texas	297,162[2]	187,297[2]	60.0[2]
Florida	11,084	0	0.0
Gulf	2,247,430	1,931,968	86.0

[1]Compiled from interviews by Hermes Hague; Fishery Statistics of the United States, 1954 to 1957 (U. S. Fish and Wildlife Service Statistical Digests 41-44) and Gulf Fisheries 1958 (U. S. Fish and Wildlife Service C.F.S. No. 2165).
[2]Estimates.

Goode's (1878) paratypes of *B. patronus* which Hildebrand (1948) found. Goode included two species. The fish from the mouth of the Rio Grande were really *B. gunteri.*

Hildebrand (1955) reported *B. gunteri* from the Gulf of Campeche west of Punta Morros, Mexico, thereby extending the range of the species, as well as the genus, far to the southward in the Gulf. Suttkus (1958) suggested that H. Hildebrand's specimens may have been *B. smithi* rather than *B. gunteri.* Hildebrand, however, noted among other things the shape of the ventral fins of the eight specimens reported from Campeche, a reliable distinguishing character, and the report of *B. gunteri* from Campeche is doubtless correct. Hildebrand (p. 200) used the phrase ". . . the discovery of this species off the coast of Tamaulipas and Campeche by the present writer . . .", but made no further mention of *B. gunteri* off Tamaulipas in his 1955 paper nor in a previous one (Hildebrand, 1954) which described trawl catches off Tamaulipas. Later Hildebrand (1958) listed *B. gunteri* as rare in the Laguna Madre de Tamaulipas, and stated the fish was seen in the catch of a commercial fisherman at Boca Ciega, just south of the Rio Grande. In May 1956, H. H. Hildebrand loaned to Edgar Arnold, of the Fish and Wildlife Service, a specimen of *B. gunteri,* 24 centimeters long, from Vera Cruz.

Caldwell's (1954) record of *B. gunteri* from Way Key (Cedar Keys), Florida, actually depended on a specimen of *B. smithi* (Suttkus, 1958), and the known eastern limit of *B. gunteri* remains at Grand Isle, Louisiana, as stated by Hildebrand (1948). Very few specimens of *B. gunteri* have been reported from the eastern part of its range. S. F. Hildebrand listed specimens from Galveston and Grand Isle, the latter being the only record from Louisiana. Suttkus (1958) expressed the opinion that *B. gunteri* did not extend east of Grand Isle.

James Cating and William Haskell, of the Pascagoula Laboratory of the U. S. Fish and Wildlife Service, gave us several fine-scaled menhaden, which were taken by trawlers that brought mixed catches of "industrial" fishes to cat-food plants in Pascagoula (Table 2). Three specimens of *B. gunteri* came from the Grand Isle region and 24 came from off the mouth of Grand Bayou Pass which leads into Bastian Bay. The latter locality is west of the Mississippi River and about 15 miles east of Grand Isle. One specimen, taken near the Chandeleur Islands in Chandeleur Sound

TABLE 2.—*Dates, depths, and fishing areas of trawl-caught menhaden landed at Pascagoula, Mississippi*

Date	Location	Depth (fathoms)	Number of specimens
Brevoortia gunteri			
7-21-59	Gulf of Mexico off Grand Isle, Louisiana	6	2
7-30-59	Gulf off Barataria Pass, Louisiana	7	1
9-17-59	Gulf off Grand Bayou Pass into Bastian Bay, Louisiana	5-7	5
9-25-59	Gulf off Grand Bayou Pass into Bastian Bay, Louisiana	7-8	2
9-25-59	Chandeleur Sound NW of North Island, Louisiana (16 *B. patronus* in sample)	2½	1
9-30-59	Gulf off Scofield Bayou, Louisiana (1 *B. patronus* in sample)	4-8	19
Brevoortia smithi			
7-8-59	Gulf of Mexico east of Mobile Ship Channel	8	4
7-29-59	Chandeleur Sound, Louisiana, off Cat Island Channel (9 *B. patronus* in sample	2-3	1
7-30-59	Gulf off Little Lagoon, Alabama (1 *B. patronus* in sample)	4	2
8-4-59	Gulf off Dauphin Island, Alabama	2-3	2
8-19-59	Chandeleur Sound, NW of North Island, Louisiana (2 *B. patronus* in sample)	3-5	2
8-21-59	Gulf between Mobile Ship Channel and Little Lagoon, Alabama	4-7	7
9-10-59	Petit Bois Island, Mississippi	—	2
9-17-59	Gulf off Perdido Bay, Alabama (1 *B. patronus* in sample)	3-5	2
9-24-59	Chandeleur Sound, WNW of North Island, Louisiana	2-3	1
9-25-59	Chandeleur Sound, NW of North Island, Louisiana (16 *B. patronus* in sample)	2½	1
10-2-59	West of Sand Island Light off Dauphin Island, Alabama	3-4	1

on September 25, 1959, was the first record east of the Mississippi River. The Chandeleur locality is about 70 miles northeast of Grand Isle, but about 120 miles from there by the seaward route around the Mississippi delta.

Gunter (1945) found *B. gunteri* in brackish-water bays. Later he recorded it from fresh water in the Mission River of Texas and listed it as euryhaline (Gunter, 1956), in which he was followed by Hubbs (1958). Less is known about the offshore range. Fish were taken in hauls at 8 fathoms, the maximum depth known for the species (Table 2). Simmons (1957) reported *B. gunteri* as common in the Laguna Madre of Texas at salinities from 20 to 60 *per mille*, and uncommon above 60.

Gunter (1945) believed the species was very common in Aransas and Copano bays, but possibly the smaller, more numerous fish were *B. patronus*. Gunter, however, caught considerable numbers of larger fish from which the type and paratypes were selected. The species is not common in the menhaden catches from Louisiana and we know of only one specimen, taken off Isles Dernières, west of Grand Isle. The available information indicates that *B. gunteri* is more common in Texas waters than in Louisiana.

Brevoortia smithi Hildebrand, 1941

B. smithi is a fine-scaled menhaden for which Hildebrand (1948) gave a range from Beaufort, North Carolina, to Indian River, Florida, saying "presumably Indian River City." V. G. Springer told us he had also taken *B. smithi* from the St. Lucie Estuary, which empties into the Indian River (coastal lagoon) about 100 miles south of Indian River City. S. F. Hildebrand learned later that *B. smithi* is also an inhabitant of the Florida west coast (Suttkus, 1958), but the account was not published. Suttkus independently made the same discovery and gave the known range of *B. smithi* in the Gulf of Mexico as Cedar Keys, Florida, to Placida, Florida. Hall and Gunter have taken small specimens from the Caloosahatchee River, thereby extending the range southward about 30 miles. Gunter (1956) and Briggs (1958) listed the species as euryhaline.

Suttkus (1958) was of the opinion that *B. gunteri* and *B. smithi* were widely separated geographically and resided in the western and eastern Gulf, respectively, with both species being overlapped in range by the more abundant *B. patronus*. Actually, the eastern and western Gulf species run together in Chandeleur Sound, Louisiana, the only known locality where three species of menhaden may be taken together.

The localities where *B. smithi* was caught by trawlers for industrial fish landed at Pascagoula, Mississippi, are shown in Table 2. Eighteen specimens were taken in Alabama waters, three in Mississippi waters, and four in Chandeleur Sound, Louisiana. A catch made by the *Deacon's Daughter* on September 25, 1959, should be noted particularly because one *B. smithi*, one *B. gunteri*, and several *B. patronus* were taken from this load, which contained more than 35,000 pounds of fish. The load was not all taken in the same drag or on the same day, but the entire catch was made in the same general area.

COMPARISON OF *Brevoortia gunteri* AND *Brevoortia smithi*

A comparison of the measurements and counts of certain characters for the specimens of *B. gunteri* and *B. smithi* taken during the present study is shown in Table 3. All the specimens fall within the limits given

TABLE 3.—*Summary of some meristic characters and measurements of fine-scaled species of* Brevoortia

[Measurements are expressed as percentage of standard length. The 25 specimens of *B. smithi* range from 191 to 257 millimeters standard length, mean 222.2 millimeters; the 30 specimens of *B. gunteri* range from 214 to 264 millimeters, mean 235.6 millimeters.]

	Number of vertebrae				
	43	44	45	46	Mean
B. smithi	—	1	15	9	45.3
B. gunteri	14	16	—	—	43.6

	Number of ventral scutes						
	28	29	30	31	32	33	Mean
B. smithi	—	—	8	9	5	3	31.1
B. gunteri	6	19	5	—	—	—	29.0

	Number of modified predorsal scales											
	35	36	37	38	39	40	41	42	43	44	45	Mean
B. smithi	1	1	—	—	2	3	1	2	6	4	3	41.9
B. gunteri	—	1	2	3	5	9	4	2	2	2	—	40.0

	Length of head						
	29	30	31	32	33	34	Mean
B. smithi	9	12	4	—	—	—	29.8
B. gunteri	—	—	2	13	12	3	32.4

	Depth of head							
	26	27	28	29	30	31	32	Mean
B. smithi	3	7	12	3	—	—	—	27.4
B. gunteri	—	—	1	4	17	7	1	30.1

	Length of pectoral fin						
	17	18	19	20	21	22	Mean
B. smithi	1	8	6	8	2	—	19.0
B. gunteri	—	—	6	13	6	4	20.3

by Hildebrand (1948) and Suttkus (1958) except that one *B. smithi* from east of the Mobile ship channel had 44 vertebrae, the first overlap in this character with *B. gunteri* that has been found.

Four specimens of *B. smithi*, 182 to 244 millimeters in standard length taken in September 1959 by three boats, have not been examined in detail; three came from off Dauphin Island, Alabama, and one came from off St. Petersburg, Florida. All examples of the fine-scaled menhaden reported here were adults, and were considerably larger than the *B. patronus* generally landed in the menhaden fishery. It seems that *B. smithi* and *B. gunteri* attain a larger size than *B. patronus*.

The places of spawning and the nursery areas of the two fine-scaled menhaden from the central Gulf coast are unknown. Presumably the fish grow up in a bay or estuary. Suttkus, however, found no *B. gunteri* in Lake Pontchartrain. Gunter and Shell (1958) found no young *B. gunteri* in White or Grand Lakes in western Louisiana, and the present authors have found neither immature *B. gunteri* nor *B. smithi* in Mississippi during 2 years of collecting small menhaden. Suttkus (1958, p. 405) said, "Certainly if *B. gunteri* does occur east of Grand Isle it does not frequent the brackish water habitat noted for it in Texas waters by Gunter (1945). The above statement is based upon several years of study of Lake Ponchartrain *(sic)* and adjoining brackish water areas during which time many thousands of specimens were examined and all were referred to the species *B. patronus* (Suttkus, 1956). Furthermore, I have examined many specimens from Mississippi, Alabama and west Florida coasts and all prove to be *B. patronus*." The fact remains that the adults of both species have been found in Louisiana waters east of the Mississippi River, and *B. smithi* has also been taken in the waters of Mississippi and Alabama. It is possible that *B. smithi* has only recently moved into the area, but it is more probable that it has been there for a long time and has only been collected since attention has been focused upon menhaden.

LITERATURE CITED

Briggs, John C. 1958. A list of Florida fishes and their distribution. Bull. Florida State Mus. (Biological Sciences), 2(8): 223-318.

Caldwell, David K. 1954. Additions to the known fish fauna in the vicinity of Cedar Key, Florida. Quart. Jour. Florida Acad. Sci., 17: 182-184.

Goode, G. Brown. 1878. A revision of the American species of the genus *Brevoortia*, with a description of a new species from the Gulf of Mexico. Proc. U. S. Nat. Mus., 1: 30-42.

———. 1879. The natural and economical history of the American menhaden. Rept. U. S. Fish Comm. for 1877, pt. 5, app. A., xii + 529 pp.

Gunter, Gordon. 1936. Studies of the destruction of marine fish by shrimp trawlers in Louisiana. Louisiana Conservation Rev., 5: 18-24, 45-46.

———. 1938a. The relative numbers of marine fish on the Louisiana coast. Amer. Nat., 72: 77-83.

———. 1938b. Seasonal variations in abundance of certain estuarine and marine fishes in Louisiana, with particular reference to life histories. Ecol. Monogr., 8: 313-346.

———. 1941. Relative numbers of shallow water fishes of the northern Gulf of Mexico, with records of rare fishes from the Texas coast. Amer. Midl. Nat., 26: 194-200.

———. 1945. Studies on marine fishes of Texas. Pub. Inst. Mar. Sci. (Univ. Texas), 1(1): 1-190.

———. 1956. A revised list of the euryhalin fishes of North and Middle America. Amer. Midl. Nat., 56: 345-354.

Gunter, Gordon, and William E. Shell. 1958. A study of an estuarine area with water-level control in the Louisiana marsh. Proc. Louisiana Acad. Sci., 21: 5-34.

Gunter, Gordon, Robert H. Williams, Charles C. Davis, and F. G. Walton Smith. 1948. Catastrophic mass mortality of marine animals and coincident phytoplankton bloom on the west coast of Florida, November 1946 to August 1947. Ecol. Monogr., 18: 309-324.

Henshall, James A. 1894. Notes on fishes collected in Florida in 1892. Bull. U. S. Fish Comm., 14: 209-221.

Hildebrand, Henry H. 1954. A study of the brown shrimp *(Penaeus aztecus* Ives) grounds in the western Gulf of Mexico. Pub. Inst. Mar. Sci. (Univ. Texas), 3(2): 228-336.

———. 1955. A study of the pink shrimp *(Penaeus duorarum* Burkenroad) grounds in the Gulf of Campeche. Pub. Inst. Mar. Sci. (Univ. Texas), 4(1): 169-302.

———. 1958. Estudios biologicos preliminares sobre la Laguna Madre de Tamaulipas. Ciencia (Mex.), 17(7-9): 151-173.

Hildebrand, Samuel F. 1948. A review of the American menhaden, Genus *Brevoortia*, with a description of a new species. Smithson. Misc. Coll., 107(18): 1-39.

Hubbs, Clark. 1958. A check-list of Texas freshwater fishes. Texas Game and Fish Comm., Inland Fish. Ser. No. 3, 14 pp.

REID, GEORGE K., JR. 1955a. A summer study of the biology and ecology of East Bay, Texas. Texas Jour. Sci., 7: 316-343.

———. 1955b. A summer study of the biology and ecology of East Bay, Texas. Part II. The fish fauna of East Bay, the Gulf beach and summary. Texas Jour. Sci., 4: 430-453.

———. 1956. Ecological investigations in a disturbed coastal estuary. Texas Jour. Sci., 8: 296-327.

———. 1957. Biologic and hydrographic adjustment in a disturbed Gulf coast estuary. Limnol. and Oceanogr., 2: 198-212.

SIMMONS, ERNEST G. 1957. An ecological survey of the upper Laguna Madre of Texas. Pub. Inst. Mar. Sci. (Univ. Texas), 4(2): 156-200.

SPRINGER, V. G., AND K. D. WOODBURN. 1960. An ecological study of the fishes of the Tampa Bay area. Florida St. Bd. Conserv., Prof. Paps. No. 1, 104 pp.

SUTTKUS, ROYAL D. 1956. Early life history of the Gulf menhaden, *Brevoortia patronus*, in Louisiana. Trans. N. Am. Wildl. Conf., 21: 390-407.

———. 1958. Distribution of menhaden in the Gulf of Mexico. Trans. N. Am. Wildl. Conf., 23: 401-410.